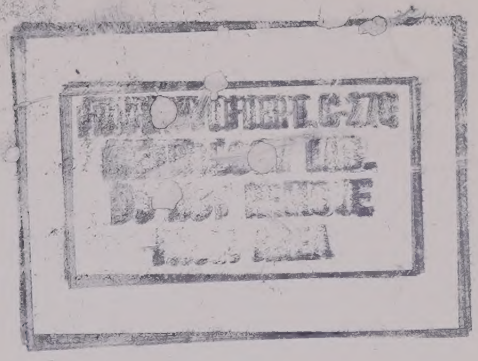
OPERATION MANUAL



CE-21A
FREQUENCY
SELECTIVE
LEVELMETER

CUSHMAN
ELECTRONICS, INC.

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[illegible]

CE-21A
FREQUENCY SELECTIVE
LEVELMETER

OPERATION MANUAL

CUSHMAN
ELECTRONICS, INC.
830 Stewart Dr · Sunnyvale, CA 94086
Telephone: Area Code 408—739-6760

5601-0041

October 1973

CUSHMAN ELECTRONICS, INC.

MANUAL CHANGE NOTICE

INSTRUMENT CE-21A MANUAL NO. 5601-0041 DATE PRINTED Oct, 1973

The following changes are necessary to bring your manual up to date. Changes are listed with the instrument serial numbers to which they apply. It is suggested that you enter these changes in your manual immediately.

OPERATION MANUAL

Page 1-2, paragraph 1.11, the Model 211 has been superceded by the 211A Bridging Probe. Operation of the 211A is the same as the 211 in every way except that the 211A has a switch which places the Probe input in either the Bridging or Terminating Mode. The Terminating mode is for 75Ω.

The last sentence of paragraph 1.11 should read "The specifications are given in Table 1-2. Table 1-2 is added below.

Page 1-3, Table 1-1. Specifications, CE-21A, under LEVEL, add parenthetical statement to ACCURACY to read:

ACCURACY (With a source return loss of ≥30 dB)

Under Frequency Response referred to 1 MHz at 0 dBm, change the first statement to read: 75Ω UNBALANCED, or BALANCED 124Ω, 135Ω, (150Ω-M1 OPTION).

Under Frequency Response referred to 10 kHz, add the word BALANCED following 600 OHM; Now reads 600 OHM BALANCED.

Under LEVEL ACCURACY, change the statement: Attenuator referred to 0 dBm ±0.25 dB, to read: Attenuator referred to 0 dBm at 1 MHz ±0.15 dB.

Add:

Table 1-2. Specifications, 211A

ITEM	CHARACTERISTIC
TELECOMMUNICATIONS EQUIPMENT COMPATABILITY	CE-21A
FREQUENCY RANGE	60 kHz to 9.1 MHz
INPUT SIGNAL LEVEL	-99 dBm to +2 dBm
LEVEL ACCURACY	±0.2 dB
MAXIMUM INPUT SIGNAL LEVEL	
R.F. (Continuous)	+20 dBm
D.C. Voltage on Input	300V
Transient Spikes	600V (peak)

ITEM	CHARACTERISTICS
INPUT IMPEDANCE	
Input Resistance	
Bridging	>100KΩ
Terminated	75Ω ±1%
Shunt Input Capacitance	<18 pF
OUTPUT LOAD	CE-21A (Set to 75Ω UNBAL, TERM)
HARMONIC DISTORTION (+0 dBm, 1 MHz Input)	-60 dB Max.
NOISE POWER RATIO (Equivalent 600 Channel System with Stop Band Slot at 2.438 MHz)	60 dB typical
POWER REQUIREMENTS	20V at 30mA, supplied from CE-21A
DIMENSIONS	
Probe Case (Excluding W.E. plug)	1.4" H (3.56 cm), .60" W (1.52 cm), 4.4" L (11.18 cm)
Cable Length (Yellow 75Ω Triax)	10 Ft. (3.05M)
Coax Plug (Excluding Connectors)	1.2" H (3.05 cm), .6"W (1.52 cm) 2.2"L (5.59 cm)
ENVIRONMENTAL	
Temperature, Operating	0° to 55°C
Temperature, Storage	-40°C to +75°C
Humidity	95% RH, 40°C
Vibration	10-55 Hz, .01" (.025 cm) P-P Ampl.
Shock (W.E. Connector Protected)	10 Ft. (3.05M) Bench Drop
Altitude	
Operative	15,000 Ft. (4.57 Km)
Non-operative	25,000 Ft. (7.62 Km)

Page 3-2, Table 3-1. Controls, Indicators and Connectors. FRONT PANEL, METER, under FUNCTION, second sentence, change -2 dBm to + 2 dBm to read -2 dB to +2 dB.

Page 3-6, paragraph 3.23, second sentence, after TERM, add the word UNBAL, now reads: Set the CE-21A INPUT to 75Ω TERM, UNBAL, whenever the probe is used.

Page 3-7, add to the OPERATIONAL NOTES:

8. When using the CE-21A or CE-21 with the CE-23A the CE-23A must be in manual mode when calibrating the CE-21A, or CE-21.

NOTE: In paragraph 3.07 and following the abbreviation EXP refers to the expanded meter scale, +2 dB to -2 + dB.

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SECTION 1
GENERAL

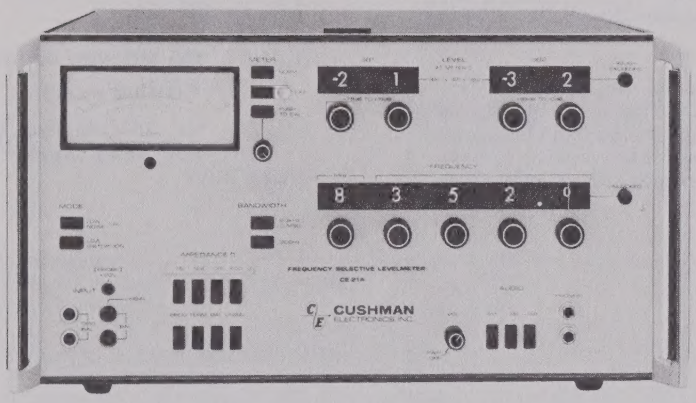


Figure 1-1. CE-21A Frequency Selective Levelmeter

DESCRIPTION

1.01 The Cushman Model CE-21A Frequency Selective Levelmeter measures signals and noise in multichannel carrier and radio multiplex systems. The instrument operates on the principle of the superheterodyne receiver, but has a metered output.

1.02 The level measurement range is from -119 dBm to +19 dBm and the frequency range is from 10 kHz to 9.1 MHz (from 4 kHz in Narrow Band). Input is through coaxial connectors and may be either balanced or unbalanced. (135Ω dual phone jacks are for balanced input only). Connection to the circuit is either bridging or terminated. Push-button selected terminating impedances are 75Ω, 124Ω, 135Ω, or 600Ω. As an option 150Ω is available in place of 124Ω.

1.03 The received frequency is set with four digital dials and is fine tuned with a continuously variable dial to a resolution of 25 Hz. Because the Local Oscillator frequencies are generated by a frequency synthesizer, measurements are stable and drift is not a problem. Long term drift is within .001%.

1.04 The level is measured with two digital attenuators and a meter. One of the attenuators may be used as a reference level storage register for ease in making measurements referred to the Transmission Level Point (TLP). The meter has a switch selected expanded scale. On this scale readings may be resolved to .05 dBm.

1.05 The CE-21A is also equipped with a selectable equivalent C-message bandwidth and a switch selected low distortion mode. This permits direct carrier or tone level-to-noise measurements on fully loaded systems. A low noise mode also may be selected.

1.06 A narrow band switch selected 200 Hz bandwidth (45 Hz optional) for pilot or single frequency measurements is also included.

1.07 Calibration is carried out without disturbing the frequency or level settings or disconnecting the instrument from the circuit. A push button selects the Calibration mode and makes all the necessary internal connections.

1.08 Modulation on the signal being monitored, AM or SSB, is recovered by a built-in detector. Either upper or lower side band may be selected. The audio output is available at the front panel phone jack or on a built-in speaker.

1.09 Two companion units are available to work with the CE-21A, either singly or as a system. The CE-23A Spectrum Display permits

sweeping and scanning a single channel, a complete group, a super group or an entire baseband. The CE-26A Signal Generator, which has synthesized frequency tuning, may be either independently tuned or tracked synchronously with the CE-21A. The three units together form a complete carrier transmission measuring system (TTS).

1.10 Specifications for the CE-21A are given in Table 1-1.

1.11 A Bridging Probe, Model 211, is available as an option. This is an active, high impedance probe. With this probe the CE-21A may be bridged across a channel transmission system without degrading or interrupting the communications link. The probe consists of an amplifier having unity voltage gain from 60 kHz to 9.1 MHz. a 20 volt connector on the CE-21A front panel provides power for the probe. The specifications are given in Table 1-1.

1.12 A BNC to Coaxial adapter (Cushman P/N 2532-0001) is supplied as an accessory with the CE-21A.

1.13 The following options may also be ordered:

M1, 150Ω in place of 124Ω input termination.
M2, 45Hz in place of 200 Hz narrow bandwidth filter.

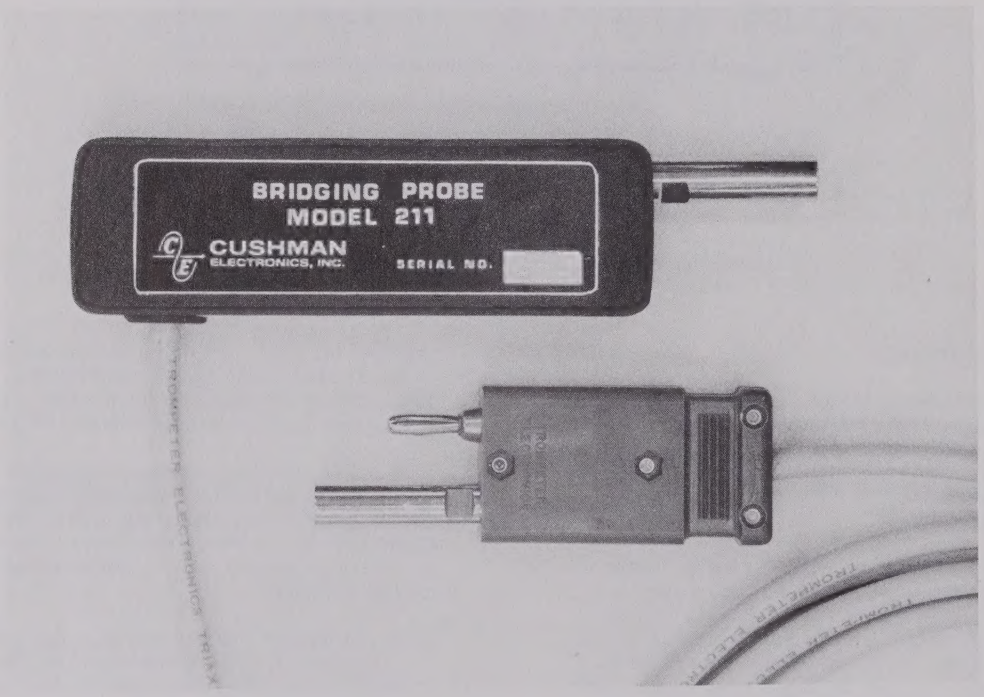


Figure 1-2. Model 211 Bridging Probe

Table 1-1. Specifications, CE-21A

ITEM	CHARACTERISTICS
FREQUENCY	
Range	10 kHz to 9.1 MHz
Digital Resolution	1 kHz
Calibrated range of continuous interpolation	1.1 kHz
Stability	≤300 Hz from 0°C to +50°C
Aging	≤150 Hz per year
LEVEL	
Range, referred to 0 dBm on Meter	
10 kHz to 650 kHz	-99 dBm to +19 dBm
650 kHz to 9.1 MHz	-99 dBm to 0 dBm
Accuracy	
1 MHz - 0 dBm, 75Ω	
25°C ±10°C	±0.1 dB
25°C ±25°C, additional	±0.1 dB
124Ω, 135Ω, (150Ω-M1 option) referred to 75Ω	±0.1 dB
600Ω referred to 75Ω-10 kHz	±0.1 db
Frequency Response referred to 1 MHz at 0 dBm	
75Ω, 124Ω, 135Ω, (150Ω-M1 option)	
60 kHz to 8.5 MHz	±0.2 dB
10 kHz to 60 kHz, 8.5 MHz to 9.1 MHz add'l	±0.1 dB
Frequency Response referred to 10 kHz	
0 dBm 600Ω	
60 kHz to 650 kHz	±0.2 dB
10 kHz to 60 kHz, additional	±0.2 dB
Attenuator referred to 0 dBm	±0.25 dB
Control	1 dB and 10 dB steps
Meter Range	
Normal	-20 dBm to +2 dBm
Expanded	-2 dBm to +2 dBm
Resolution	0.05 dBm
INPUT IMPEDANCE	
Unbalanced	75Ω, 124Ω, 135Ω, 600Ω, (150Ω-M1 option) and 10kΩ shunted by approximately 30 pF
Balanced	75Ω, 124Ω, 135Ω, 600Ω, (150Ω-M1 option) and 20KΩ shunted by approximately 18 pF
INPUT COMMON MODE REJECTION (Balanced Input)	≥30 dB
INPUT DC RATING	Each input to ground, 400 volts (Bridging Mode only). Do not apply DC in terminating mode.
BANDWIDTH	
Broad	
3 dB	2.3 kHz ±10%
60 dB	≤5.0 kHz
Equivalent Noise	1.74 kHz ±10%
Narrow	
3 dB	200 Hz ±10%
60 dB	≤800 Hz
Narrow, Optional	
3 dB	45 Hz ±10%
60dB	≤450 Hz

Table 1-1. Specifications CE-21A (cont.)

ITEM	CHARACTERISTICS
INTERNAL DISTORTION ATTENUATION (LOW DISTORTION)	
Harmonic	
For 60 dB sensitivity increase, 300 kHz to 9 MHz	≥70 dB
For 50 dB sensitivity increase, 60 kHz to 300 kHz	≥65 dB
Noise Power Ratio (Typical)	
Equivalent 600 channel system with stop slot at 2.438 MHz or 70 kHz	
For 40 dB sensitivity increase	≥55 dB
Equivalent 1800 channel system with stop band slot at 8.002 MHz or 70 kHz	
For 40 dB sensitivity increase	≥45 dB
INTERMEDIATE FREQUENCIES	
I. F. 1	12 MHz
I. F. 2	80 kHz
I.F. REJECTION (I.F. 1 AND/OR I.F. 2)	≥70 dB
IMAGE FREQUENCY REJECTION (24 MHz to 33.1 MHz)	≥65 dB
OUTPUTS, NOMINAL, AT METER ZERO	
PHONES (Phone Jack)	
Output Impedance	8Ω
Audio Speaker Power	1 Watt
DC Recorder (BNC)	
Output Impedance	1 kΩ
Output Open Circuit Voltage, DC	-790 mV
Spectrum Display	
80 kHz Out (BNC) A (black)	
Output Impedance	600Ω
Voltage	800μV (600Ω)
L.O. In/Out (BNC) B,C (black)	
Impedance	50Ω
Voltage	1.5V p-p (50Ω)
Tracking Generator	
1st L.O. Out (BNC) D (black)	
Output Impedance	50Ω
Voltage	50 mV (50Ω)
2nd L.O. Out (BNC) E (black)	
Output Impedance	50Ω
Voltage	10 mV (50Ω)
POWER REQUIREMENT	115/230V ±10%, 50-400 Hz, 50 Watts
DIMENSIONS	
Height	9-1/4" (23.5 cm)
Width	17-1/4" (43.82 cm)
Depth	18-1/4" (46.36 cm)
WEIGHT	28 pounds (12.7 kg)

Table 1-1. Specifications CE-21A (cont.)

ITEM	CHARACTERISTICS
ENVIRONMENTAL	
Temperature	
Operating	0°C to 50°C
Storage	-40°C to +75°C
Humidity	95% RH, 40°C
Vibration	10 to 55 Hz, .01" (.03 cm) peak to peak amplitude
Shock	4" (10.16 cm) bench drop
Altitude	
Operative	15,000 ft. (4.57 km)
Non-operative	25,000 ft. (7.62 cm)

Table 1-2. Specifications Model 211 Bridging Probe

ITEM	CHARACTERISTICS
Frequency	60 kHz to 9.1 MHz
Signal Level	-99 dBm to +2 dBm
Level Accuracy	±0.1 dB (referred to 1 MHz, 75Ω load)
Frequency Response	
60kHz to 9.1 MHz	±0.1 dB
Degradation of 75Ω Transmission Line through path due to probe bridging	
Bridging loss at 1 MHz	0.01 dB
Frequency Response at 9.1 MHz	0.01 dB
Harmonic Distortion	<-60 dB with +2 dBm input
Load Impedance	75Ω unbalanced shunted by 30 pF
Connecting Cable	10 feet yellow triax 75Ω
Noise Figure	Degrades CE-21A N.F. by less than 1 dB
Input Characteristics	
Input Resistance	>100 kΩ
Input Shunt Capacitance	<10 pF
Output Characteristics	
Output Impedance	75Ω Max.
Connectors	
Input	Western Electric 75Ω type
Output	
Baseband	Western Electric 75Ω type
Power	Banana Plug
Safe Power Handling Capacity	
Continuous	+20 dBm
Transients	400 volts peak
Noise Power Ratio	60 dB typical
Power Requirements	+20V ±1%, 50 mA Max.
Dimensions	
Active Probe	
Height	1.38" (3.51 cm)
Length	4.44" (11.28 cm) excluding WE Connector
Width	0.6" (1.52 cm)
RF Triax Cable	
Length	10 ft. (3.05 m)
Coax plug	
Height	1.2" (3.05 cm)
Width	0.6" (1.52 cm)
Length	2.2" (5.59 cm) excluding WE Connector and Banana Plug

Table 1-2. Specifications Model 211 Bridging Probe (cont.)

ITEM	CHARACTERISTICS
Environmental	
Temperature	
Operating	0°C to 50°C
Storage	-40°C to +75°C
Humidity	95% RH, 40°C
Vibration	10 to 55 cps, .01" (.03 cm) peak to peak amplitude
Shock	10 ft. (3.05 m) bench drop (with WE Connector protected
Altitude	
Operative	15,000 ft. (4.57 km)
Non-Operative	25,000 ft. (7.62 km)

SECTION 2
INSTALLATION

UNPACKING AND INSPECTION

2.01 When unpacking the CE-21A Frequency Selective Levelmeter, inspect the packing box and the instrument for signs of possible damage. Verify satisfactory performance as outlined in the operating instructions (Section 3) of this manual. If the instrument is damaged, fails to operate properly or if any of the accessories are missing, file a claim with the transportation agency, or, if insured separately, with the insurance company.

INSTALLATION PROCEDURES

2.02 Power Requirements

2.03 The CE-21A operates from a 115 or 230 volt (±10%) AC source, 50 to 400 Hz. Power consumption is 50 watts. A 3 amp. slo-blo fuse in the CE-21A provides protection (1-1/2 amp for 230V operation). When the auxiliary instruments (CE-23A, CE-26A) are used, these units obtain their power through the CE-21A.

2.04 Grounding Requirements

2.05 The CE-21A is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. To preserve this protection when operating the instrument from a two-wire outlet, use a three-prong to two-prong adapter and connect the green lead on the adapter to ground.

2.06 Warm-up Requirements

2.07 There are no special warm-up requirements for the CE-21A. The instrument is ready for use as soon as it is turned on. Operational Calibration should be performed periodically, however, for the first thirty minutes of use.

2.08 Conversion to Rack Mount

2.09 The CE-21A can be mounted in a standard 19-inch equipment rack. The hardware required for converting the CE-21A from cabinet to rack mount is not supplied with the instrument but is available upon request. If the CE-21A is to be converted for rack mounting, obtain the necessary kit from Cushman Electronics, and proceed as follows:

a. Remove the two screws in each handle.

b. Install the L-shaped brackets with the mounting lip forward; use the previously removed screws and attach to the handles.

c. Carefully slide the instrument into equipment rack and secure with screws provided.

PREPARATION FOR RESHIPMENT

2.10 It is recommended that the shipping box and foam packaging be kept in case it becomes necessary to return the instrument to the service point or factory for service or repair.

2.11 The following paragraphs contain a general guide for repackaging of the instrument for shipment.

NOTE

If the instrument is to be shipped, attach a tag to the instrument identifying the owner, and indicating the service or repair to be accomplished. Include the model number and full serial number of the instrument. In correspondence, identify the instrument by model number, serial number, and part number.

2.12 If the original container is to be used, proceed as follows:

a. Place the instrument in the original container. (If the original container is not available, one can be purchased from Cushman Electronics.)

b. Ensure that the container is well sealed with strong tape or metal bands.

2.13 If the original container is not used, proceed as follows:

a. Wrap the instrument in plastic or heavy paper before placing in an inner container.

b. Place packing material around all sides of the instrument.

c. Place the instrument and inner container in a heavy carton or wood box, and seal with strong tape or metal bands.

d. Mark the shipping container: "DELICATE ELECTRONIC INSTRUMENT," "FRAGILE."

SERVICE OR REPAIR

2.14 In the event service or repair is required, contact:

CUSHMAN ELECTRONICS, INC.
Customer Service Department
830 Stewart Drive
Sunnyvale, California 94086
Telephone: (408) 739-6760

Repair service for Cushman Electronics equipment is available at:

BCS Associates, Inc.
940 North Fern Avenue
Orlando, Florida 32803
Area Code: (305)
Telephone: 896-4881

Reshal Associates
219 West University Drive
Arlington Heights, Illinois 60004
Area Code: (312)
Telephone: 398-7660

SECTION 3
OPERATION

CONTROLS AND INDICATORS

3.01 The locations of the front and rear panel controls and indicators are shown in Figures 3-1 and 3-2 and are listed and briefly described in Table 3-1.

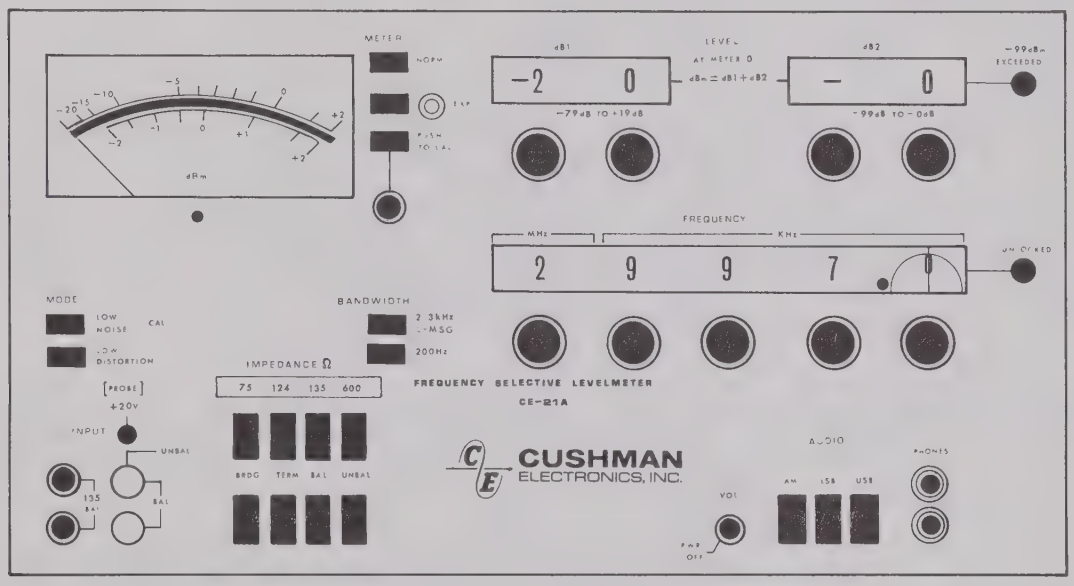


Figure 3-1. Front Panel Controls and Indicators

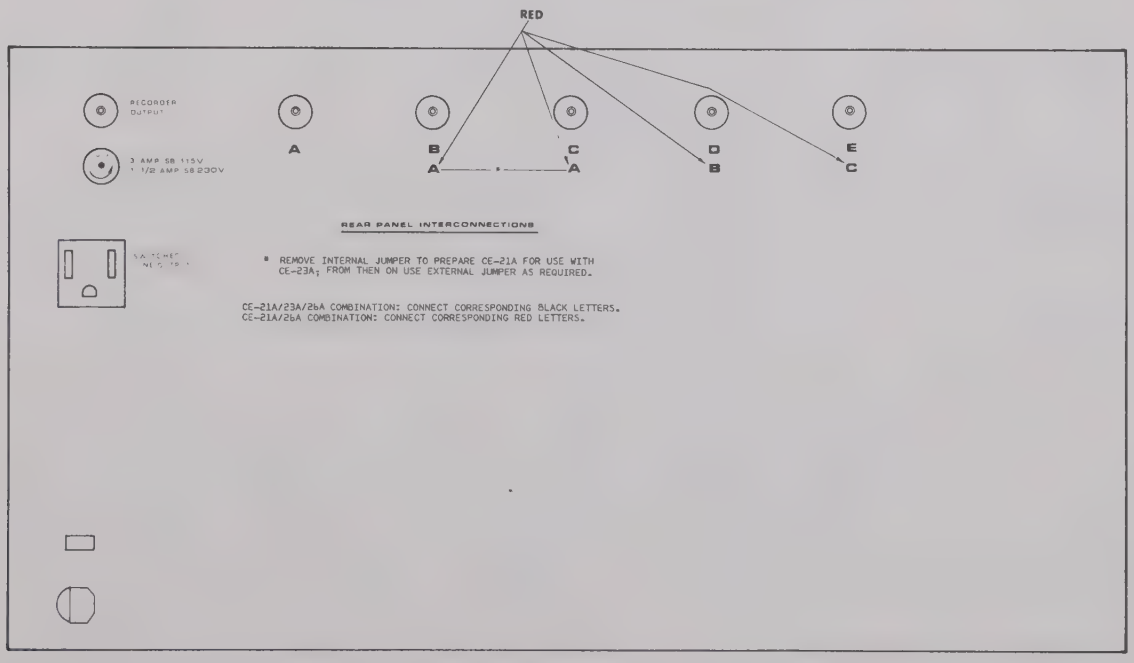


Figure 3-2. Rear Panel Controls and Connectors

Table 3-1. Controls, Indicators and Connectors

CONTROLS, INDICATORS AND CONNECTORS	SCHEM. REF.NO.	DESCRIPTION	FUNCTION
FRONT PANEL			
METER	M1001	Meter	Indicates signal level with ±0.1 dB or ±0.05 dB resolution. Meter scale is calibrated from -20 dBm to +2 dBm and from -2 dBm to +2 dBm. Two blue "CAL" marks are the CAL set points for the normal or expanded ranges.
Meter range selector NORM/EXP	S1004	Two pushbutton, mechanically interlocked switch	Selects appropriate meter range.
EXP	DS1002	Indicator lamp	Lights when expanded meter scale is selected.
PUSH TO CAL	S1005	Pushbutton switch	Sets CE-21A to calibrate mode. Must be depressed for "on" and depressed again for "off."
Cal adjust	R1005	Potentiometer	Adjusts gain of meter circuits so that meter reads 0 dBm (on both scales) in calibrate mode.
LOW NOISE/LOW DISTORTION	S1001	Two pushbutton, mechanically interlocked switch	Switches 20 dB of attenuation from RF stages to 2nd IF stages when low noise is selected and the reverse for low distortion.
BANDWIDTH	S1006	Two pushbutton, mechanically interlocked switch	Selects wide (2.3 kHz 'C-MSG') or narrow (200 Hz) bandwidth. The 2.3 kHz bandwidth provides the same noise level measurements as C-message weighted instruments.
INPUT 135 BAL	J1001/ J1002	Dual tip-sleeve jack	Accepts a dual tip-sleeve plug (WE-241A). Input selectors must be in TERM, BAL, 135Ω. This jack is disconnected when any other type input is selected.
INPUT UNBAL/BAL	J1003/ J1004	Coaxial Jacks	Used as a dual jack for balanced inputs or used singly (upper) for unbalanced inputs. These jacks are used for all inputs except 135Ω balanced lines.
BRIDG/TERM	S1002	Two pushbutton, mechanically interlocked switch	Permits selection of either a Bridging or Terminating input.
IMPEDANCE Ω 75, 124, 135, 600	S1003	Four pushbutton mechanically interlocked switch	Switches in the termination impedances indicated. Either 75Ω, 124Ω, 135Ω, or 600Ω INPUT selector button must be depressed.
BAL/UNBAL	S1007	Two pushbutton, mechanically interlocked switch	Selects either Balanced or Unbalanced input.
dB1 dB2	S1008/ S1010 S1015/ S1018	Rotary switches	Selects desired signal level in 10 dB and 1 dB steps. Level is indicated by the algebraic sum of the two displays plus the meter reading. One display may be used to set a reference level.
-99 dBm EXCEEDED	DS1010	Indicator lamp	Lights when readings of dB1 and dB2 total more than -99 dBm.

Table 3-1. Controls, Indicators and Connectors (continued)

CONTROLS, INDICATORS AND CONNECTORS	SCHEM. REF.NO.	DESCRIPTION	FUNCTION
FRONT PANEL			
FREQUENCY MHz/kHz	S1009/ S1011/ S1013/ S1016	Rotary switches	Selects first four digits of frequency to be monitored.
	R1009	Potentiometer	Selects fifth (100 Hz) digit of frequency to be monitored.
UNLOCKED	DS1011	Indicator lamp	Lights if phase-locked loop of frequency synthesizer becomes unlocked.
AUDIO			
VOL	R1008	Potentiometer	Adjusts audio level reproduced by speaker or headphones.
PWR OFF	S1014	Switch	Applies or removes AC power to CE-21A.
AM/LSB/USB	S1017	Three push-button, mechanically interlocked switch	Permits selection of AM, lower sideband, or upper sideband of signal to be monitored.
PHONES	J1005/ J1006	Phone jacks	For standard dual or single tip-sleeve phone plug. Upper jack is used for single plug. Speaker is disconnected when phones are plugged in.
PROBE +20V	J1007	Jack	+20V for active probe.
REAR PANEL			
A (black)	J4005	BNC connector	Used to connect 80 kHz signal to CE-23A Spectrum Display.
B (black) A (red)	J4006	BNC connector	Used for 12-21 MHz LO input from CE-23A Spectrum Display.
C (black) A (red)	J4007	BNC connector	Used to connect 12-21 MHz LO to CE-23A Spectrum Display.
D (black) B (red)	J4008	BNC connector	Used to connect 12-21 MHz LO to CE-26A Signal Generator, or CE-23A Spectrum Display.
E (black) C (red)	J4009	BNC connector	Used to connect 11.92 MHz LO to CE-26A Signal Generator, or CE-23A Spectrum Display.
RECORDER OUTPUT	J4002	BNC connector	Used to record signal level.
3 AMP SB 115V 1-1/2 AMP SB 230V	F4001	Fuse	Provides overcurrent protection for 115V or 230V operation.
SWITCHED LINE OUTPUT	J4003	Jack	Provides line power to auxiliary equipment.
115/230V SWITCH	S4001	Slide switch	Selects either 115V or 230V AC power input.

OPERATION

3.02 TURN-ON

3.03 Before connecting the CE21A to the AC power source make certain that the 115/230V switch on the rear panel is set for the AC line voltage to be used.

3.04 Turn the VOL control clockwise out of the PWR OFF position. No warm-up time is required, however, the Operational Calibration should be performed periodically for the first 30 minutes of use.

3.05 OPERATIONAL CALIBRATION

3.06 Calibration of the CE-21A is semiautomatic. When the PUSH TO CAL switch is depressed the input circuit is switched to 75 ohms, an internally generated calibration signal is provided, the frequency of the 1st LO is preset for 1 MHz and the attenuators are adjusted for a 0 dBm input. The meter is then manually set to zero. This calibrates the instrument for all available input impedances and for all frequencies within the range of the CE-21A.

3.07 Perform the following steps:

a. Depress the PUSH TO CAL switch. All the LEVEL and FREQUENCY readouts are now darkened except the 100 Hz frequency control.

b. Depress the LOW NOISE, the 200 Hz BANDWIDTH, and the METER EXP switches.

c. Rotate the 100 Hz frequency control until a peak reading is obtained on the meter.

d. Zero the meter on the EXP meter scale by adjusting the control below the PUSH TO CAL switch.

e. Depress the METER NORM switch. The reading on the upper meter scale should be 0 dB ±0.1 dB.

f. Depress the 2.3 kHz BANDWIDTH switch. The meter reading should be 0 dB ±0.1 dB.

g. Depress the LOW DISTORTION switch. The average reading should be 0 dB ±0.1 dB. See Operational Note 7.

h. Depress the LOW NOISE switch. Depress the PUSH TO CAL switch to release it. The instrument is now ready for use.

3.08 SINGLE FREQUENCY (PILOT) MEASUREMENTS

3.09 Make the following control settings:

a. Set the INPUT switch to either BRDG or TERM. In the BRDG mode the impedance is 20kΩ for balanced inputs and 10kΩ for unbalanced inputs.

b. In either the BRDG or TERM mode depress the proper impedance switch.

NOTE

The CE-21A reads dBm in either the BRDG or TERM mode as long as the circuit is properly terminated, either by the circuit load (BRDG) or by the CE-21A terminating resistance (TERM).

c. Set the BAL/UNBAL switch for the desired condition.

d. Set the BANDWIDTH switch to 200 Hz.

e. Set the MODE switch to LOW NOISE.

f. Set dB1 and dB2 to 0 dB unless approximate level of signal is known. In that case set dB1 to that level. (See note to 3.11, b.)

g. Dial in the frequency of the signal to be measured with the FREQUENCY selector controls. (BANDWIDTH may be set to 2.3 kHz until signal is found if necessary, and then switched back to 200 Hz.)

h. Using a patch cord, connect the proper input connector(s) to the line or equipment on which tests are to be made.

i. Adjust dB1 for an on-scale meter reading and peak the level by adjusting the 100 Hz frequency control dial.

j. Adjust dB1 for a meter reading as close to 0 dB as possible. If greater meter resolution is required depress the METER EXP switch and check 100 Hz frequency control dial for a peak reading.

k. The absolute level in dBm is the algebraic sum of dB1, dB2 and the meter reading. For example: dB1 reads -27 dBm, dB2 reads 0 dBm, and the meter reads +1.3 dBm the absolute level is (-27) + (0) + (1.3) = -25.7 dBm.

l. To disconnect the audio output refer to Operational Note 5.

3.10 RELATIVE SIGNAL LEVELS

3.11 To measure the level of one signal with respect to another or to a reference level (TLP) proceed as follows:

a. Follow the steps of paragraph 3.9 a-j, except in step f. set dB2 to the level of the first signal or to the reference level (TLP).

b. The difference between the first (dB2) and second (dB1) signals will be the reading of dB1 plus the meter reading. For example if dB2 is set to -25 dBm and dB1 is set to -30 dBm and the meter reads +0.5 dBm the second signal is (-30 dBm) + (+0.5 dBm = -29.5 dBm below the first. The absolute level of the second signal will then be (-25 dBm) + (-30 dBm) + (+0.5 dBm) = -54.5 dBm.

NOTE

Either dB1 or dB2 may be used to set the levels if desired, but dB1 is preferred for the signal being measured because it may be set to a higher positive level, dB2 therefore is used to set the reference level.

3.12 TONE LEVEL ON SSB CHANNELS

3.13 To measure test tone levels on a SSB channel follow the procedure of paragraph 3.9 a-l except substitute the following in place of step g.

a. If a chart is available showing the Channel Center Frequency (for a 2 kHz test tone) or the channel frequency for a 1 kHz test tone, these should be followed.

b. Otherwise the frequency dialed in should be the channel carrier frequency plus the tone frequency for USB or the channel carrier frequency minus the tone frequency for LSB. See Operational Note 1 for audio monitoring of test tones.

3.14 IDLE CHANNEL NOISE MEASUREMENT

3.15 To measure Idle Channel Noise follow the procedure of paragraph 3.9 a-f, and h-l.

a. Put a 2kHz tone on the idle channel and tune the CE-21A 2 kHz above (USB) or 2 kHz below (LSB) the channel carrier frequency. A chart showing Channel Center Frequencies may be used. See Operational Note 2 and Figure 3-3.

b. Adjust the 100 Hz variable frequency dial for a maximum reading on the meter (adjust dB1 for an on-scale reading).

c. Remove the 2 kHz tone and switch the BANDWIDTH to 2.3 kHz.

d. Adjust sensitivity with dB1 (or dB2) for an on-scale meter reading, see paragraph 3.9, j-k. If the meter suddenly pins as sensitivity is increased slightly, depress the LOW DISTORTION switch and continue the measurement. When the LOW DISTORTION mode is used the signal to noise ratio is reduced by 20 dB so the meter will show small random variations. See Operational Note 3.

NOTE

The algebraic sum of the readings of dB1 and dB2 (not including the meter reading) must not exceed -99 dBm. An additional -20 dBm is available on the meter scale.

e. The noise level in dBm will be the algebraic sum of dB1, dB2 and the meter reading. See paragraph 3.9, k.

f. To obtain a noise level reading in dBrn noise measurement units, add 90 to the noise reading in dBm. For example: if the noise reading is -35 dBm the measurement in noise units will be -35 dBm +90 = +55 dBrn. Since the 2.3 kHz BANDWIDTH filter is essentially equivalent to a C-message-weighted filter the reading will be in dBrnC. See Operational Note 4.

3.16 AUDIBLE MONITORING

3.17 To monitor noise or other signals with the headphones or the built-in speaker of the CE-21A follow the procedure of paragraph 3.9 a-f, h.

a. Set the BANDWIDTH switch to 2.3 kHz

b. Dial in the frequency of the channel carrier plus 2 kHz (USB) or minus 2 kHz (LSB) and center the filter on the channel. See Operational Note 2. In order for audio tones to have their proper pitch the filter must be centered with a 2 kHz tone. Adjusting the 100 Hz frequency control dial will vary the pitch of the signals.

c. Depress the proper AUDIO switch, USB or LSB.

d. If headphones are to be used, plug them into the PHONES jack. If single plug phones are used they must be plugged into the upper jack. The speaker is disconnected whenever the phones are plugged in.

e. Adjust dB1 (or dB2) for 0 dBm on the

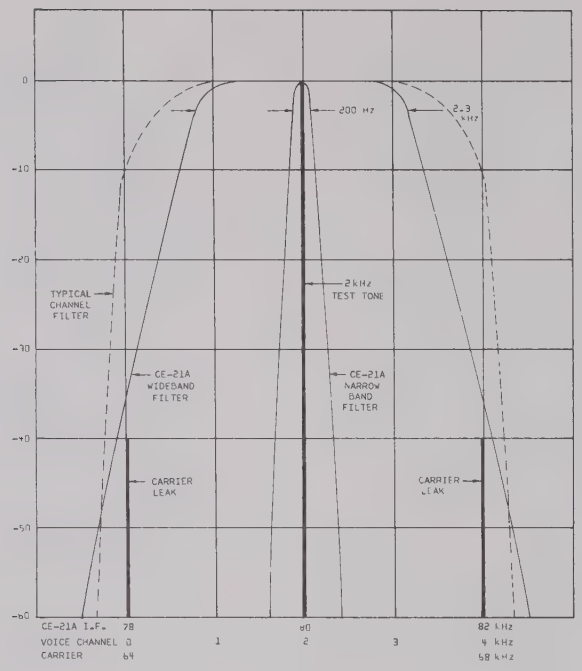


Figure 3-3 CE-21A Filters Centered on Carrier Channel

meter and adjust VOL control for a suitable listening level.

3.18 FREQUENCY RESPONSE MEASUREMENTS WITH CE-26A

3.19 The CE-21A may be used with the CE-26A to make frequency response runs on communications channels or on amplifiers or other equipment. When the proper rear panel interconnections are made the CE-26A functions as a tracking signal generator, controlled by the CE-21A.

3.20 Make the rear panel connections between the CE-21A and the CE-26A by connecting corresponding red letters together. Red B to red B and red C to red C. A connection between red A and red A on the CE-21A is only necessary if the internal jumper has been removed for operation with the CE-23A.

3.21 Turn on the CE-26A and make the following control settings:

a. Set the TUNING mode selector switch to EXT.

b. Set the LEVEL controls for the desired level.

c. Set the OUTPUT to UNBAL 75Ω or BAL 124Ω, 135Ω or 600Ω as required.

d. Connect the proper output jacks to the line or equipment with a patch cord.

e. Set the OUTPUT switch to ON.

f. Adjust the CE-21A for an on-scale reading of the meter following the procedure or paragraph 3.9 a-1.

3.22 The CE-21A may also be used with the CE-23A for a visual display. Consult the CE-23A manual for operating procedures and interconnections.

USING THE 211 BRIDGING PROBE

3.23 Connect the 211 Bridging Probe to the CE-21A, making certain that the banana plug on the Coax Plug enters the Probe Power receptacle. Set the CE-21A INPUT to 75Ω TERM whenever the Probe is used. Connect the Active Probe to the circuit and follow the operating procedures given above.

FIELD MAINTENANCE

3.24 The CE-21A is provided with a Power Line Fuse on the rear panel. As a replacement use a 3 Amp Slow-Blow for 115 VAC or 1-1/2 Amp Slow-Blow for 230 VAC.

3.25 With the exception of the line fuse, adjust-

ment, repair or replacement of components in the CE-21A should only be performed by authorized repair personnel.

OPERATIONAL NOTES

1. If it is desired to monitor a test tone (1-3 kHz) on a SSB channel with phones or the speaker the USB or LSB switch may be depressed. As long as the tone is centered in either the 200 Hz or 2.3 kHz BANDWIDTH the pitch of the audio tone heard will be approximately 2 kHz. The reason for this is, the carrier reinsertion oscillators are 2 kHz away from the 80 kHz second IF. If the 2.3 kHz filter is centered on a 2 kHz tone (See note 2 below) other tones within the range of the filter will be at their proper pitch. Level measurements should only be made, however, on tones centered in the BANDWIDTH filter.

2. To center the 2.3 kHz BANDWIDTH filter on a 2 kHz test tone: Tune the CE-21A 2 kHz above (USB) or 2 kHz below (LSB) the channel carrier frequency. Use the 200 Hz BANDWIDTH and adjust for maximum level with the 100 Hz Frequency Control dial. Switch to the 2.3 kHz BANDWIDTH position. This approximately centers the 2.3 BANDWIDTH filter on the SSB channel. See Figure 3-3.

3. In the LOW NOISE mode 20 dB of attenuation is switched out of the input circuit and 20 dB attenuation is switched into the IF to give the best signal-to-noise ratio. In the LOW DISTORTION mode 20 dB attenuation is switched into the input circuit and 20 dB attenuation is switched out of the IF. The purpose of the LOW DISTORTION mode is to prevent the input mixer from being overloaded by adjacent channel signals. When the meter pins with a slight increase in sensitivity this is an indication of overload. Below -79 dBm the condition is the same for either mode since the 20 dB IF attenuation must be removed to obtain this sensitivity.

The meter will show the small random noise fluctuations below this level. See Operational Note 7.

4. The BANDWIDTH designation 2.3 kHz (1.74 kHz) relates the bandpass of the CE-21A to the concept of Equivalent Noise Bandwidth and the C-message-weighted curve. Noise measurements made with the CE-21A 2.3 kHz filter are essentially equivalent to those made with a C-message-weighted filter.

5. To disconnect the audio output from the speaker and PHONES jacks depress one of the AUDIO switches slightly untill all the switches come out to the off position.

6. If the meter remains pinned as when using the CE-23A with the CE-21A for visual monitoring of channels or groups, depress one of the meter switches slightly until they all come to the off position.

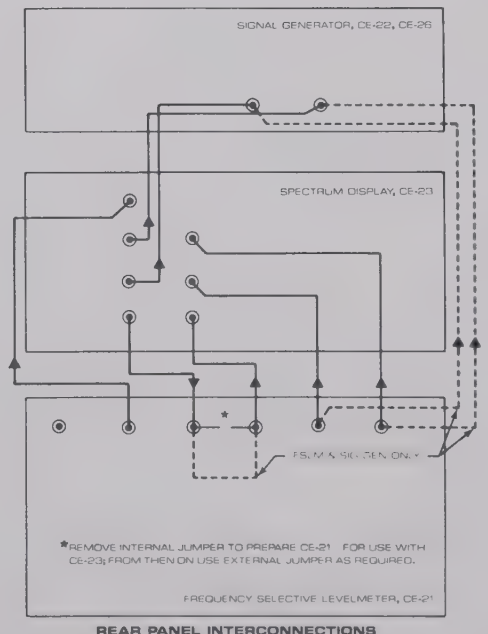
7. Whenever the CE-21A is placed in the LOW DISTORTION mode the meter will show small random fluctuations due to the reduced signal-to-noise ratio in this mode. Accuracy is slightly reduced due to these fluctuations. The instrument should never be calibrated in the LOW DISTORTION mode.

USING THE CE-21A IN PLACE OF THE CE-21

The CE-21A may be used instead of the CE-21 with the CE-26 or with the CE-23 or with both the CE-26 and the CE-23 in the TTS system. The rear panel connections are the same for either the CE-21 or the CE-21A.

Make the rear panel interconnections according to the adjacent drawing when the CE-21A is used with the CE-26 and/or the CE-23.

The color coded letters on the CE-21A rear panel match with the markings on the CE-26A and the CE-23A.


SIGNAL GENERATOR, CE-22, CE-26
SPECTRUM DISPLAY, CE-23
*REMOVE INTERNAL JUMPER TO PREPARE CE-21 FOR USE WITH CE-23; FROM THEN ON USE EXTERNAL JUMPER AS REQUIRED.
FREQUENCY SELECTIVE LEVELMETER, CE-21

REAR PANEL INTERCONNECTIONS

DEAR CUSTOMER:

Every effort has been made to ensure the accuracy of this manual. If an error is discovered please notify us on the postpaid cards attached.

Please indicate where the error has been made. To improve future manuals your comments are requested.

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